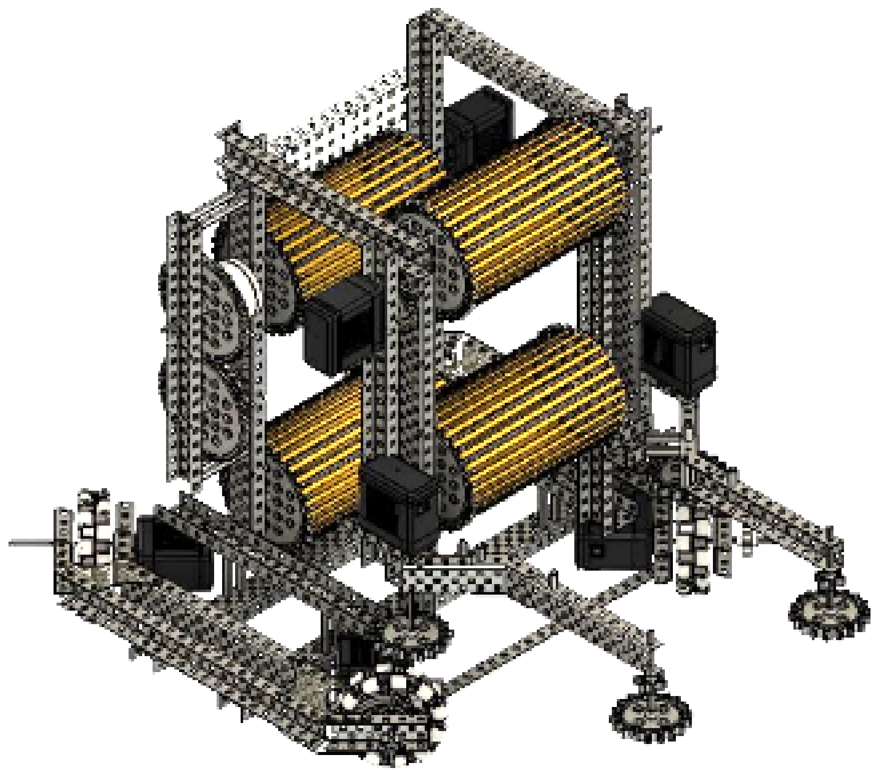
Planetary 2-Way Ratchet: Final Report	Team 7110A	Software Used: Fusion 360 Educational Version



Brief introduction

Our team was involved in the VEX VRC competition which enabled us the opportunity to create a physical robot during the COVID-19 pandemic. We designed our robot to compete in the VEX Change Up Competition, so easily maneuvering both red and blue balls was essential for our robot. Our design solution to best maneuver both red and blue balls is a series of 4 rollers that would intake, shoot, and eject balls based on input from an optical sensor. However, one challenge was powering four rollers with two motors. Our solution is fixing the bottom roller and powering the two middle rollers with one motor. The top roller then is powered by the second motor. Another difficulty was running the middle two rollers, both of which have very different and very specific roles on the robot, from one motor. For red balls, the rollers need to spin in opposite directions. For blue balls, both rollers need to spin in the same direction (clockwise), but the ejection roller (the rear roller) needs to be at a higher velocity than the intake roller (the front roller). Any mechanism used to meet these requirements must be as small as possible due to sizing constraints. Our solution is the Planetary 2-Way Ratchet. After some effort, this Planetary 2-Way Ratchet enabled us to meet all of our design constraints and handle red and blue balls with ease.

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Explanation

The Planetary 2-Way Ratchet allows one motor to run our middle two rollers. We attached the mechanism on the back roller's axle which is directly run by a motor. The ratchet transfers the motion of the axle to a large gear. We attached another gear below the ratchet-controlled gear to reserve the direction of rotation. Attached to the bottom gear is a small sprocket that is chained to the sprocket that powers the bottom front roller. By using the Planetary 2-Way Ratchet, the rollers move in the directions and speeds needed to make sure nothing gets stuck internally. No matter the direction of the back roller, the front roller would move in the same direction (clockwise). When the back roller starts moving backward (clockwise) when ejecting a ball, the front roller does not switch direction; instead, it moves at a slower speed. Because of this, if the ball is too high in the robot, it would move down because the back roller is moving faster. If the ball is too low, it would move up because the front roller is spinning clockwise. This mechanism functions perfectly alongside our optical sensor which switches the direction of the back roller based on the color of the ball. This mechanism is also optimal in a match because it allows the robot to intake a ball and eject another ball at the same time.

Explanation of how you used Fusion 360 to create your new part

We used Fusion 360 educational version to create the Planetary 2-Way Ratchet. First, we downloaded a VEX parts library to use as a reference for spacing and sizing. We started the part with 4 gears (one sun gear, 2 planet gear, and one ring gear). A planetary bracket was created to keep the planet gears stationary. All gears rotate freely from their axles. This enabled us to have the ring gear spinning in one direction and the sun gear spinning in the other direction. Furthermore, the 12 tooth sun gear is spinning 3 times slower than the 36 tooth ring gear. From here we added the inner ring which would use 4 pawls to transfer power from the ring and sun gears. Depending on how the pawls are oriented, the output would change speed, instead of direction, when the input changes direction. While creating this part, we used the "opacity control" and "isolate" features to work on specific parts of the Planetary 2-Way Ratchet. During testing, we used the "export to .stl" feature to easily prototype the mechanism. Finally, "joint sets" were used to simulate real-life movement. Overall, we implemented numerous features in Fusion 360 to create, test, 3D print, render, and present this part.

Brief conclusion

Throughout the process of designing the Planetary 2-Way Ratchet, we learned a lot about the design process. We've used this process for years, but with the complexity of our problem, it was a one-of-a-kind experience that enabled us to learn a great amount. Because we were the ones who built and tested our team's robot, we were very familiar with the challenge we needed to overcome. The software enabled our team to try several designs. We learned a lot about ratchet mechanisms as we tried to figure out a way to convert two-directional motion into constant one-directional motion. We also learned the valuable skill of 3D modeling with Fusion 360.

We plan on using 3D modeling to solve future challenges. Being able to create a specific object that perfectly solves a problem is an amazing experience which allows us to better solve engineering challenges.

3D design software is an incredible resource for competitive robotics, especially this year since we have very limited access to our robot, due to Covid-19. We used 3D design software to create prototype solutions for the robot while staying safe and practicing social distancing during the pandemic.

We both plan on becoming engineers in the future since we both enjoy solving technical problems and creating creative designs, and 3D design software is perfect for that field. 3D design software enables us to create models sustainable, without wasting material and resources. Essentially, our imagination is the limit, so we can create optimal design solutions to any problem we encounter. Since the engineering field is often correlated to physical design problems, 3D design software is perfect for our future engineering careers.